Pigeon pea crop leaf disease recognition using SVM

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Abstract

Pigeon pea is the major pulse crop of north Karnataka. Detection of disease of pigeon pea is one of the foremost difficult task. Sometimes agricultural consultants ought to take facilitate of varied sources to spot the diseases of plants. The misinterpretations of plant diseases typically lead to wrong chemical choice, ensuing in injury of crops. Hence, in this paper the automated recognition of the diseases at earlier stages is vital in addition as economical for the farmer purpose. In this paper leaf miner and leaf spot diseases of the pigeon pea crop are identified at the earlier stage. To diagnosis the leaf disease, preprocessing techniques applied to resize and enhance the image quality. Then ROI based image segmentation is done to the leaf disease part. For feature extraction, shape and texture features are extracted for the leaf part. Finally SVM technique is used for recognition of type of disease in the leaf part.

Keywords: *Pigeon pea crop, SVM, Leaf spot, Leaf minor Diseases.*

1. Introduction

In India fifty eight percent of people livelihoods depend on the agriculture. India ranks second worldwide in farm output [16]. Pulse crop production is the major source of income of Indian farmers. With unique characteristics pigeon pea is one of major pulse of crop. Pigeon pea cultivated around 14% of the total gross crop area by providing 20% of the pulse production of India. Production and quality of the seeds will be reduced because of the crop diseases [1].

In the plant, most of the diseases found in the leafs, stems and fruits [2]. Crop disease can be recognized by using different image processing technologies. The common diseases in the pigeon pea crops are Alternaria blight Alternaria alternate, Anthracnose Colletotrichum spp, Cercospora leaf spot Cercospora cajani,White mold (Sclerotinia rot) Sclerotinia sclerotum. Identification of these diseases to be made in the early stages for good crop yield and quality.

In this paper two diseases are recognized, leaf miner and leaf spot. The leaf spot disease identified by, the disease first appears as small circular to irregular necrotic spots or lesions on older leafs. Lesions coalesce causing leaf blight and defoliation. During epidemics, lesions appear on young branches and cause their tips to dry and die back. Fluffy mycelial growth or concentric zonations on lesions are seen [17] and leaf miner disease appear on the leafs with large irregular papery mines on the dorsal surface.

2. Related Work

There are lots of works carried out in the plant disease identification.
Some of the technologies discussed in the below paragraphs.

In [1], author proposed detection and recognition technique for leaf disease detection of plants. This paper consists of three stages 1. Preprocessing, 2 features extraction and 3. Recognition. Till these days people identify the disease by naked eye. The main aim is to detect the crop leaf disease. Data set is first preprocessed and its texture and shape features are identified and extracted and input to the SVM classifier with BPNN for the classification.

In [2], researcher used Color Features and Artificial Neural Network of classification a range of diseases affecting bananas. In this work the first step is converting the image from RGB to gray and HSV color space then extracts Histogram of template and color features. The researcher uses the color features including Mean and Standard Deviation. So as to use these features to create a knowledge base that is used later by the classifier for training. use the feed-forward back propagation neural network to classify the banana disease. One of the important missing things in this system is the lack of segmentation process .the process of segmentation is very important in separating the injured part from the proper part of the leaf image and even if the results of the diagnosis are good, the possibility of more than one disease in the leaf is possible. Therefore, it is necessary to use segmentation method such as clustering to separate the different diseases from the healthy part.

In [3], author proposed OTSU and SVM classifier for the crop disease recognition. Color image is converted into YCbCr after the contract enhancement preprocessing the image. OTSU method is applied to the disease part to separate it from the healthy part. Image is segmented by using Gabor filter. Then texture features

are extracted. These features are input to SVM classifier for the disease frecognition.

In [4], author proposed SVM technique to recognize the disease of the grape leaf. Image is segmented by using K means clustering. Its features like color and textures are identified. Lastly SVM is classifier used to recognize the disease of the leaf with the accuracy of 88.89%.

In [5], author developed the model which helps in early detection of the disease, which helps in increase the production. In this paper different features are extracted for the classification. Random forest and logistic regression, support vector machine have been used for the classification purpose.

In [6], author proposed support vector machine and k-nearest neighbor algorithm for automatic disease detection of the chili plant leaf disease. Used GLCM feature extraction technique for the disease classification and tested in the many datasets.

In [7], author proposed an image processing techniques for the rice disease detection. Image is segmented and color and shape features are extracted by using SIFT for the analysis purpose. The diseases identified here are paddy blast and Brown spot diseases.

In [8], author presented image processing and machine learning approach for identification of disease of the crop leaf. The dataset is of potatos collected from plant village. The segmentation method and SVM method used for the classification of the disease with 95% of 300 images.

In [9], author presented an algorithm in the segmentation for the classification and detection of the plant leaf diseases. Genetic algorithm used for the image segmentation purpose.

In [10], author introduced the framework to detect and classify the diseases accurately. Dataset captured by using digital camera. Preprocessing, segmentation and feature extraction performed on the crop leaf images. The features extracted are applied to the SVM, ANN and naïve bayes classifier used to classify the disease.

In [11], author proposed technique to identify and classify the grape using SVM classifier. Disease region is identified by using K Means clustering and its color and texture features are extracted. Finally classification technique used to detect the disease of the crop with 88.89% accuracy.

In [12], author proposed GLCM technique to detect and identify to know the leaf is healthy or diseased. Kernel function and support vector machine used for the classification purpose. Dataset of 800 images are used for the training and testing purpose. N-fold approach used for the evaluation purpose. It shows accuracy of 99.83%.

In [13], author proposed algorithm to detect infected part in the leaf. The paper has 4 parts preprocessing, segmentation using Lloyd's OR K Means algorithm, feature extraction using GLCM, classification using SVM. Median filer used for the removal of the noise which fading of the edges.

In [14], author collected leaf sample from the farmer and applied segmentation method to separate disease region from the healthy part. And features are extracted and applied them to the SVM classifier.

In [15], author introduced hybrid form in three forms. In first form image conversion and enhancement techniques are adopted, to overcome low noise and illumination. GLCM, curvelet, image moments, and complex gabor filter used for feature extraction. Neuro fuzzy classifier used for classification. Dataset used here are plantvillage with 90% accuracy.

The comprehended review of various work discussed are filled the gaps for further research and the overall idea has been gathered in agriculture image processing. The survey gives the scope for various clustering algorithms and efficient bio-inspired algorithms for the segmentation process. The factors that affect leaf images are analyzed and clearly understood from the survey. The literature survey of crop disease detection approaches helps to analyze the various crops and their diseases. The idea carried out in this research was found from the literature survey.

2. Methodology

The proposed system for detection and classification of type of the disease by using SVM classifier is having following main modules.

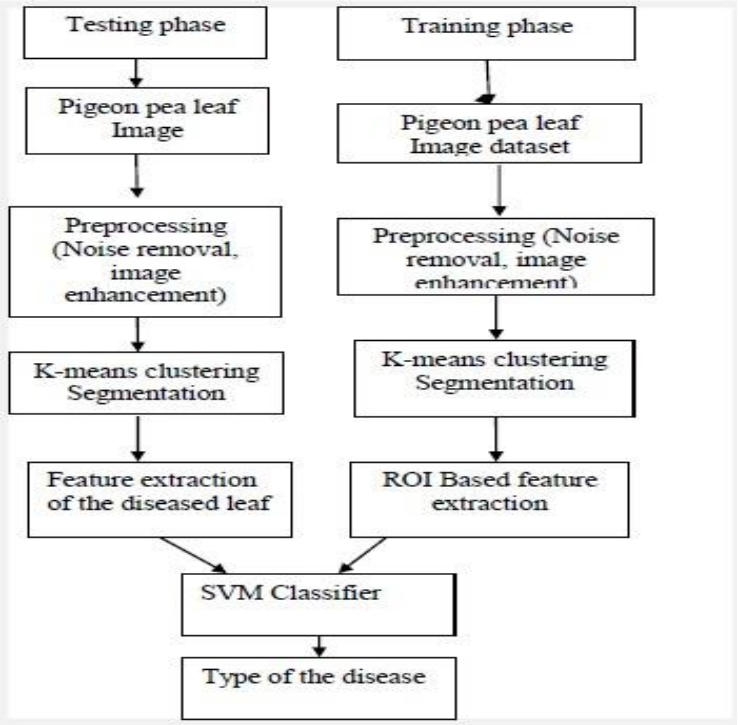


Fig 1. Proposed methods for crop leaf disease recognition.

1. Image Dataset

Images for the proposed in this paper are pigeon pea crop leaf images. Images are collected from the Kalaburagi and Bidar district in Karnataka state, India. Images are collected in the duration October, November, December by using digital Sony camera with 12MP by keeping leaf on the black cloth with the height of 15 CM far. In this paper, 2 diseases of pigeon pea crop are recognizing. Hence collected 100 images of 2 disease leaf types.

2. Image Preprocessing

In the initial step of proposed system, the given input image is processed before passing it to the main system. The preprocessing of the image includes image resizing, contrast adjustment, brightness adjustment, image cropping, image rotation etc. The output of the preprocessing will be the lab image which will be suitable for next processing. Images are resized to [255*255] from the original resolution to speedy process the image. Once the images are resized, they are restored from blur or degrading. To remove the noise from the image, median filter is used.

val = double(median(funsort(win))); v1(m,n) = val;

Once the noise is removed, image is enhanced by using DWT and wiener filtering.

3) Texture scanning and segmentation

In this the input image is segmented based on the color bands of the lab a*b*. (CIE color space, L* define 0 for black and 100 for white. The a* define negative for green and positive for red. b* define negative toward blue and positive toward yellow).The segmentation will be achieved by using the k-means clustering at t multiple levels. The cluster is nothing but the group of the pixel belonging to the same color bands.

The equations for RGB are as follows which use in the color based segmentation is. The image pixels are grouped into the similar grouped of 'K' as follows:

(1)
$$R = \sum_{x=1,y=1}^{x=w,y=k} \left(\frac{R(I(x,y))}{\text{wxh}} \right)$$

(2)
$$G = \sum_{x=1,y=1}^{x=w,y=k} \left(\frac{G(I(x,y))}{\text{wxh}} \right)$$

(3)
$$B = \sum_{x=1,y=1}^{x=w,y=k} \left(\frac{B(I(x,y))}{\text{wxh}} \right)$$

I(x,y)={image(p1,p2..pn = K(1,2,3..n)}

Each of these pixels will exhibit the property based on the individual color band. Every Pixel in the image is compared with each other and side pixel for grouping. The K means clustering will use the mean value instead of the average value. The clustering of the pixel with the data value of the pixel in the same color band in the image will help the system to group the pixels as follows.

□(□□□□□□□, □□□□) = □ {□(□□ − □□) □ }(Xi-cj) (4)

4) Feature extraction

Feature Extraction of the leaf images are performed by using function regionprops(). The image features are extracted from the image part of segmented. The functions used are regionprops(), bwconncomp() methods. The connected components form the input image is extracted based on the 8 cc values. These connected co-ordinate values are passed for the regionprops() for the feature extraction.

Algorithm 1: Texture feature extraction Input: Pigeon pea crop leaf image Output: 12 texture features

Start

Step 1: Resize the image to [255,255] from the original image.

Step 2: Perform the restoration and image enhancement pre-processing operation.

Step 3: Apply the k- means clustering for segmentation. And segment the disease part and non-disease part.

Step 4: Apply the regionprops function to the disease segmented part and extract the all the features of image.

Step 5: In the extracted features, use the only contrast, correlation.

$$\text{contrast} = \sum_{n=0}^{Ng-1} n^2 \sum_{|i-j|} \text{Pd}(i,j) \quad (5)$$

Correlation= $\sum_{i,j=0}^{n-1} Pi,j\left[\frac{[(i-\mu i)(j-\mu j)]}{\sqrt{(\sigma i^2)(\sigma j^2)}}\right]$ (6)

Step 6: store these values as the feature vector.

5. SVM classifier

The purpose of SVM is to classify the data set with boundaries and extent it to nonlinear boundaries. SVM becomes prominent when pixel map is used as the dataset values as input. It gives high accuracy equivalent to neural network with elaborated features. By designing the kernel function, SVM can be applied to the complex data and this model is efficient in both linear and nonlinear data handling. It uses the kernel classes for the classification of the input dataset, which is directly applied to data not needed in the feature extraction. Support vector machine consists of two approaches: • linearly separable • nonlinearly separable.

The main purpose is to decide whether linear or nonlinear separable is to be applied because we have utilized the decision boundary technology for the classify of the dataset, it may end up to the nearer dataset compare to other set. When data is not linearly separable, straight line is not available.

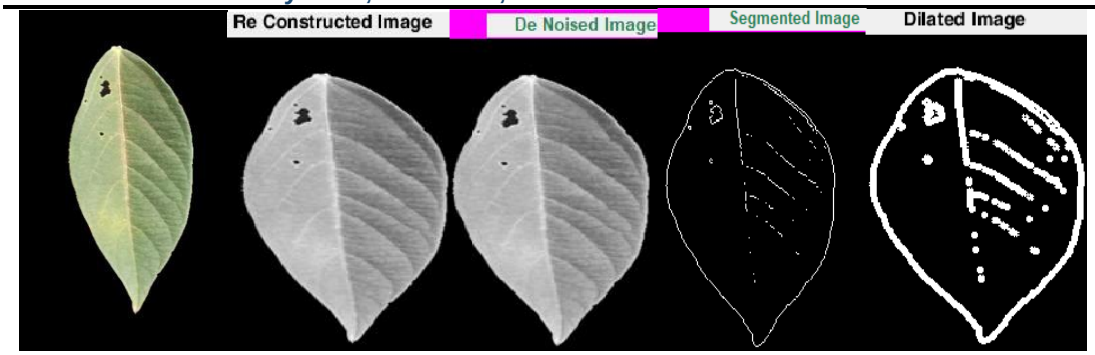
6. Experimental results

The experimentation carried out on the pigeon pea leaf images. The project implemented on the intel core i3 processor with 4 GB RAM using MATLAB 7.11. The dataset of the pigeon pea leaf images are took in the north Karnataka Kalaburagi, Bidar district in the months of October to December and prepared dataset with help of the agriculture scientist. The images are captured by using Sony digital camera with 20MP camera. Total 80 images are taken, in which 40 images are of leaf minor disease and leaf spot disease. The fig 2. Shows sample images of leaf minor and leaf spot disease

b)

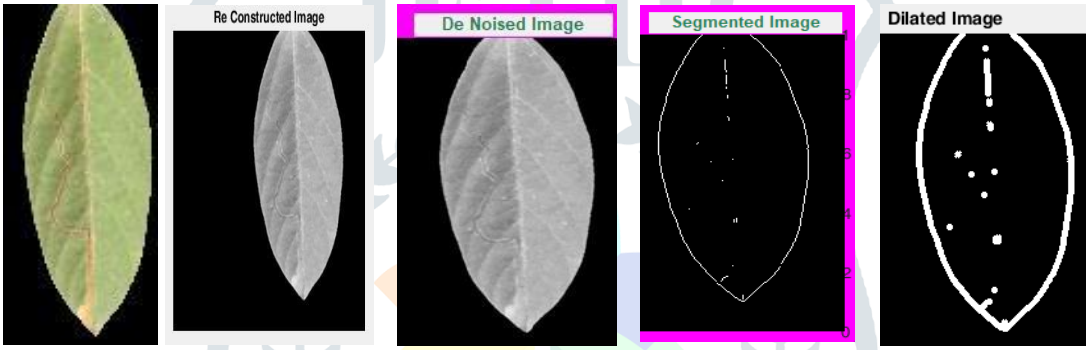
Fig 2. a) Leaf minor image b) leaf spot image

Initially, images are resized to [255,255] from the original resolution for the faster processing. Then applied median filter for the noise removal and DWT, wiener filter for the image enhancement. Image is segmented to extract the disease part of the crop by using k means clustering at t multiple levels.

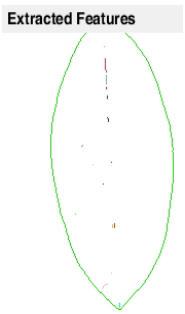


1.a) 1.b) 1.c) 1. d) 1.e)

1.f)



2.a) 2.b) 2.c) 2. d) 2.e)



2.f)

Fig 3. Images of the 2 type of diseases pigeon pea 1. Leaf minor and 2. Leaf spot a)Input image b) Reconstructed image c) De-noised image d)Segmented image
e) Dilated image f) Extracted features image.

Regionprops function applied to disease part of the image and extracted the texture features of the image. This function extracted all the features of the image, in that 15 features as shown in the following figure are extracted for the further processing.

Leaf type	Eccentricity	Circularity	Area	Mean	Standard Deviation	Variance	Diameter	Smoothness	Compact	Kurtosis
Leaf Miner 1	0.886792936	2.163720275	389	87	21.34690489	3.0733	22.25512	11.12755794	1	2.99E-07
Leaf Miner 2	0.9258201	2.645751311	2	188	0	0	1.595769	0.797884561	1	6.23E-05
Leaf Miner 3	0.942809042	3	3	190	0.707106781	0.5	1.95441	0.977205024	1	4.42E-05
Leaf Miner 4	0.99223899	8.04211291	15	164	2.81724488	195.266	4.370194	2.185096861	1	1.47E-05

Leaf Miner 5	0.999376694	28.32710514	36	178	7.285563753	6.1545	6.770275	3.385137501	1	1.67E-05
Leaf spot 1	0.992156742	8	8	179	1.732050808	18	3.191538	1.595769122	1	7.15E-05
Leaf spot 2	0.942809042	3	3	176	0.707106781	0.5	1.95441	0.977205024	1	0.000184
Leaf spot 3	0.942809042	3	3	176	0.707106781	0.5	1.95441	0.977205024	1	0.000184
Leaf spot 4	0.866025404	2	2	184	0.5	0.125	1.595769	0.797884561	1	0.000276
Leaf spot 5	0.997037031	13	13	182	2.753785274	115.0139	4.068429	2.034214473	1	3.59E-05

Fig 4. Texture features of the pigeon pea disease leaf images.

For the classification purpose, SVM classifier is used. SVM is the supervised classifier. As shown in the figure, it will plot the boundary for the features, specify features belong to that boundary or not. It has been given the maximum 400 iterations. Depending on the disease it makes take its own iterations. The given below figure shows the iterations for the leaf spot disease.

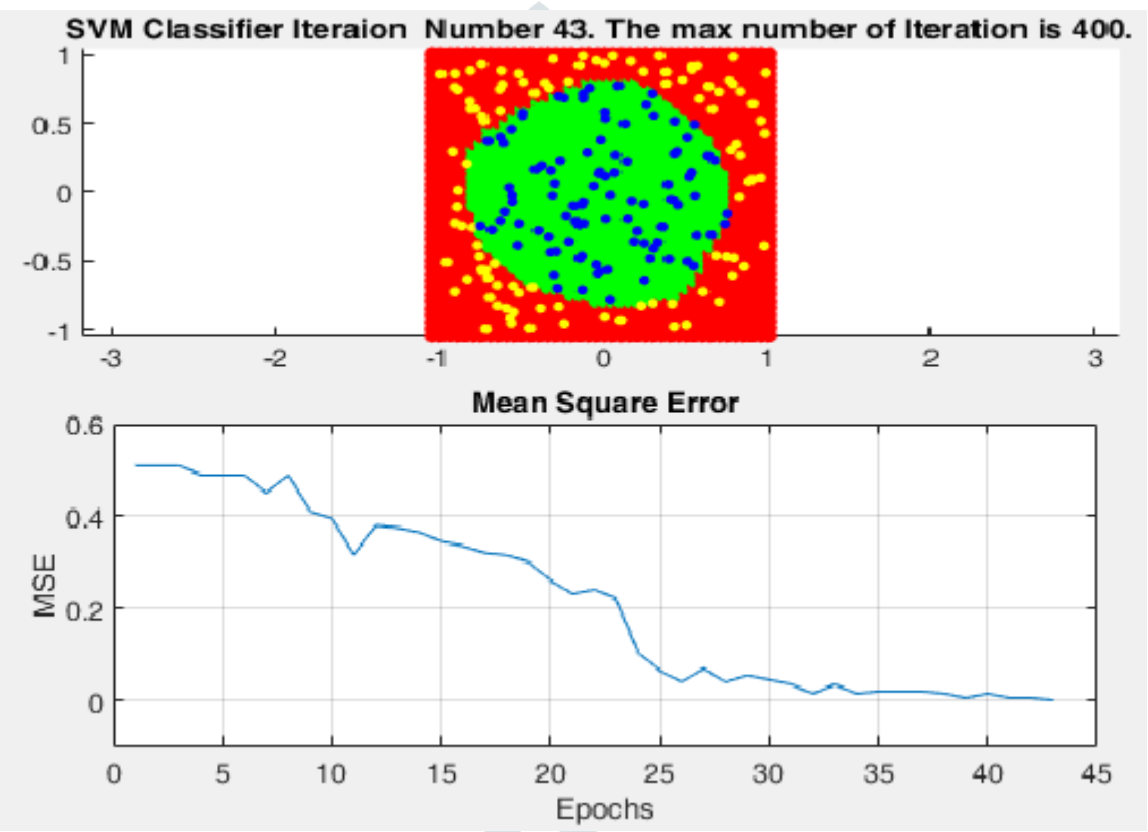


Fig 5. SVM Classification Iteration and Mean square error.

- **Training Phase**

In the training phase, computations of 13 texture features are done. A class labeling is done with the consult to the agriculture scientist. It is stored as the knowledge based.

- **Testing Phase**

In the testing phase, computations of all textures are done for the disease to be classified. The K-NN classifier is used for the test image whether it disease image and if it is then what type of the disease.

Dataset	Leaf spot	Leaf minor
Classification accuracy rate	93%	90%

Table1. Experimental results for classification percentage of proposed method.

7. CONCLUSION

In this paper, a method for classification pigeon pea leaf images as disease or not is proposed. Median and wiener filter is used for the filtering. The texture feature is important characteristics used for the disease identification. The SVM is used as the classifier. The image processed for the extraction of the image features which are used

for the extraction of the pixel information. This feature set is later used for the classification of the dataset. The proposed method shows that for leaf minor and leaf spot are 93% and 90%. The proposed method explores various possibilities in implementing specific computer aided diagnosis system for pigeon pea leaf diseases.

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